CATRA RESEARCH INSTITUTE
• ISSN 2720 - 9644 (print)
• ISSN 2721 - 0871 (online)
IJESSS
INTERNATIONAL JOURNAL OF ENVIRONMENTAL, SUSTAINABILITY AND SOCIAL SCIENCE
Indexed By :

THE RELATIONSHIP BETWEEN CLIMATE RISK DISCLOSURE AND PERFORMANCE ON MINING COMPANIES: EVIDENCE FROM A DEVELOPING ECONOMY

Volume: 4
Number: 5
Page: 1576 - 1594

Reon MATEMANE[1], Nikita GRACA[2]
[1]Faculty of Economic and Management Sciences, Department of Financial Management, University of Pretoria, Hatfield 0028, South Africa
[2]University of Pretoria, South Africa
Corresponding author: Reon Matemane
Email: reon.matemane@up.ac.za

Article History:
Received: 2023-08-17
Revised: 2023-09-01
Accepted: 2023-10-16

Abstract:
The main aim of this study is to develop an unweighted climate risk disclosure index to assess whether climate risk disclosure predicts mining companies' performance. The catastrophic nature of climate risk has become more topical in recent years. However, academic research efforts have been directed at climate risk from the perspective of developed economies only, and more needs to be understood about it in developing economies. Two hundred sixteen firm observations in the mining sector for 2016 through 2021 were analyzed using descriptive statistics and estimated generalized least squares with a seemingly unrelated regression period. The results suggest that climate risk disclosure is significant in predicting company performance as proxied by earnings per share (EPS), economic value added (EVA), and return on equity (ROE). Policymakers and regulators should encourage companies to intensify climate risk disclosure to maximize value and benefit relevant stakeholders. The study contributes to the ongoing debates on climate risk by focusing on the extractive industry and mining sector in a developed economy setting. Methodologically, the study developed an unweighted disclosure checklist that can guide companies on pertinent climate risk issues to disclose.

Keywords: Climate Risk, Disclosure, Performance, Mining Companies, Developing Economies, South Africa

Cite this as MATEMANE, R., GRACA, N. (2023). "The Relationship Between Climate Risk Disclosure and Performance on Mining Companies: Evidence from a Developing Economy." International Journal of Environmental, Sustainability, and Social Science, 4 (5), 1576 - 1594.

INTRODUCTION

According to Kouloukoui et al. (2018), climate change is the fluctuation of severe climate and weather conditions, which can cause irreparable damage to the planet and people. Climate change has become very topical in recent years because of its imminent risks to the lives and livelihoods of different parts of the world (Handayani et al., 2020). These risks include physical, environmental, and infrastructure damage (Qin et al., 2020). The use of fossil fuels and associated greenhouse gas emissions are among the primary causes of climate change, also known as global warming.

Intense development and industrialization in developed economies have contributed immensely to climate risk or global warming (Franken & Schütte, 2022). The irony, however, remains that developing countries are generally less prepared for climate risk and, therefore, are likely to suffer the consequences compared to their developed counterparts (Eriksen et al., 2021). In order to industrialize their economies, most developed countries mainly depended on mineral resources from developing countries. Green minerals used for decarbonization are still mainly sourced from

CATRA RESEARCH INSTITUTE
• ISSN 2720 - 9644 (print)
• ISSN 2721 - 0871 (online)
IJESSS
INTERNATIONAL JOURNAL OF ENVIRONMENTAL, SUSTAINABILITY AND SOCIAL SCIENCE
Indexed By :
GARUDA Google Crossref ROAD INDEX COPERNICUS OneSearch ISJD sinta 4 EBSCO Clarivate Analytics

developing countries (Erdoğan et al., 2021). These resources continue to be sourced from the extractive mining sector in developing economies.

Mining is, therefore, a unique sector for two reasons. First, it is an extractive industry providing fossil fuels for industrialization worldwide (Brodny & Tutak, 2020). It has, therefore, contributed significantly to climate change (Haddaway et al., 2022). Ironically, another unique feature of mining is that it is also a source of minerals such as copper, nickel, cobalt, lithium, platinum group metals, and other minerals that are pertinent for decarbonization, green energy, and reversing global warming (Murguía & Bastida, 2023). All these minerals are also sourced from developing economies, which continue to make them essential to study from a climate risk perspective (Gustafsson et al., 2022). The mining sector is, therefore, among the most vulnerable to climate change compared to other sectors.

Global agreements have been reached about how countries must mitigate the effects of climate change. Brown, Alexander, Arneth, Holman, and Rounsevell (2019) contend that 195 countries agreed on climate change adaptation, mitigation, and finance in light of the damaging effects of greenhouse gas emissions and their contribution to global warming. It was done through the auspices of the Paris Agreement to ensure that the temperatures do not rise to above 1.5 degrees Celsius above pre-industrial levels by 2050 (Meinshausen et al., 2022). South Africa is a signatory to the Paris Agreement and is bound to contribute to climate change adaptation, mitigation, and finance (Jegede & Makulana, 2019). Moreover, as a country whose economy is mainly dependent on mining, including coal and other carbon-intensive industries, South Africa is also classified as the most significant greenhouse gas emitter in the continent and the 12th in the world (Ebhuoma, 2022; Vera et al., 2022). There is an enormous expectation for each country, including South Africa, to participate actively in decarbonization efforts.

Not only are governments at the country level expected to do something about climate risk, but Multiple and diverse groups of stakeholders also expect companies to mitigate climate risk and disclose pertinent information in this regard (Adamkaite et al., 2023; Flammer et al., 2021; Guthrie et al., 2020). This view is supported by Henningsson (2019), who suggested that consumers and society like to associate with brands that are more conscious about societal and environmental issues, including climate risk. On the other hand, providers of capital, such as investors and lenders, strongly consider the extent to which companies are exposed to climate risk when making resource allocation decisions (Flammer et al., 2021; Garel & Petit-Romec, 2021; Henningsson, 2019). All these indicate that the interested stakeholders expect climate risk disclosure from the companies.

Despite the importance of climate change risk, especially among extractive industries such as mining, literature has primarily focused on developed countries and neglected developing economies despite their role and contribution to the subject matter (Simpson et al., 2023; Wahh et al., 2020). Furthermore, studies that sought to investigate the economic consequences of climate change contain inconclusive and mixed findings (Von Arx & Ziegler, 2014). Some studies found no relationship between climate risk disclosure and performance (Eleftheriadis & Anagnostopoulou, 2015; Lee, 2012), while others found a positive relationship (Fifka, 2013; Lee et al., 2015). As a result, the consequences of climate risk disclosure still need to be fully understood (Borghei, 2021). It is exacerbated by the scarcity of literature in the developing economy context.

The need for more literature on climate risk disclosure, especially in developing economies, is ascribed to two main challenges. The first is data availability, and the second relates to the lack of a universal standard or disclosure framework on the subject (Nowiski, 2018). The two are interwoven because the lack of a universal disclosure framework means that the companies report on climate risk differently without a standard to follow, making comparability challenging. For example, in the USA, companies must disclose climate risk based on the Securities Exchange Act of 1934: Regulation

CATRA RESEARCH INSTITUTE
• ISSN 2720 - 9644 (print)
• ISSN 2721 - 0871 (online)
IJESSS
INTERNATIONAL JOURNAL OF ENVIRONMENTAL, SUSTAINABILITY AND SOCIAL SCIENCE
KSI
Indexed By :
GARUDA Google doi Crossref ROAD INDEX COPERNICUS oneSearch ISJD sinta 4 EBSCO Clarivate Analytics

S-K (SEC). In the UK, the companies are required to disclose climate risk-related information based on Task Force on Climate-Related Financial Disclosures (TCFD) requirements, while European companies use EU Directive 2016/234 (2014/95/EU) (Gatzert & Reichel, 2022; Ho, 2022).

Several risk disclosure studies have been conducted in South Africa. The majority focused on risk in general. Studies such as Agyei-Mensah and Buertey (2019), Elshandidy et al. (2022), and Raemaekers et al. (2016) all investigated corporate risk disclosure in general without specific focus on climate risk despite its increasing significance and the existential threat it poses to people and planet, especially in extractive industries and mining.

This study aims to develop an unweighted climate risk disclosure index based on various frameworks, including JSE sustainability disclosure guidance. This index is used to establish whether there is a relationship between climate risk disclosure and the performance of listed mining companies. Climate risk disclosure score was allocated to each company and then regressed against profitability and related firm performance measures. The study contributes to the broader environmental, social, and governance literature by developing a novel unweighted climate risk disclosure index that can be used for consistent and comparable reporting of climate risk in a developing economy context. The study confirms the relationship between climate risk disclosure and company performance. Policymakers, regulators, and practitioners should intensify their efforts to encourage companies to disclose their exposure to climate risk. The rest of the paper covers a literature review and the development of hypotheses, followed by the methodology, results, and conclusion.

Literature Review, Theoretical Frameworks. Consistent with prior literature such as Kouloukoui, Sant'Anna, da Silva Gomes, de Oliveira Marinho, de Jong, Kiperstok & Torres (2019) and Odell et al. (2018), this study uses a multi-theory approach to explain a complex phenomenon of climate risk disclosure and how it relates to company performance. The multi-theory approach is warranted, given the complex nature of the phenomenon under investigation and the context of the study. The complexity of the context lies in the fact that South Africa is not only the 12th most significant greenhouse gas emitter in the world, but it is also one of the biggest producers of green resources such as platinum metal groups, and it is plagued by poverty, unemployment, and inequality despite its endowment with natural resources (Ebhuoma, 2022; Vera et al., 2022; Dikgwatlhe & Mulenga, 2023).

The theories considered appropriate for this study and applied in prior studies involving disclosure and reporting are stakeholder, agency, legitimacy, and signaling theories. The agency theory was first pioneered by Jensen and Meckling (1976), who posited that the agents are responsible for maximizing the shareholders' value. These shareholders represent agents who hire managers or agents to look after their interests in a business setting (Jensen & Meckling, 1976). Disclosure of pertinent information, such as climate risk, is how the management can account for the shareholders and reduce agency costs (Flammer et al., 2021).

Stakeholder theory, on the other hand, extends the accountability of the management beyond shareholders (Hoang, 2023). It posits that management should protect the interests of all the stakeholders, including customers, employees, suppliers, and society in general. It becomes particularly relevant in climate risk disclosure since the management has to report companies' exposure to climate risk by including the information that will help all the stakeholders, not only the shareholders, to make informed decisions (Alkurdi et al., 2019; Guthrie et al., 2020). Management can be privy to the inside information on climate risk that is not readily available to external stakeholders. It is referred to as information asymmetry. Should adequate climate risk disclosure be made, it will be easier for the affected stakeholders to understand the risk profile of the companies and make informed decisions (Alkurdi et al., 2019).

CATRA RESEARCH INSTITUTE
• ISSN 2720 - 9644 (print)
• ISSN 2721 - 0871 (online)
IJESSS
INTERNATIONAL JOURNAL OF ENVIRONMENTAL, SUSTAINABILITY AND SOCIAL SCIENCE
Indexed By :

Importance of Climate Risk Disclosure. Adamkaite et al. (2023) argued that, in recent years, the extent to which companies respond to societal and environmental issues has become increasingly more critical to multiple stakeholders. Therefore, this means that maximizing shareholders' wealth is no longer the only yardstick through which the companies' overall standing is measured. Corporate social responsibility in general and environmental, social and governance (ESG) have become more critical to investors, consumers, lenders, and society in general when assessing companies' overall well-being (Adamkaite et al., 2023; Zumente & Bistrova,2021). In the realm of ESG, the environmental pillar is the most important when prioritized against all the other two, social and governance (Matemane et al., 2022). This argument is supported by Brogi and Lagasio (2019), who investigated the association between firm profitability and ESG and found that awareness of environmental issues within the banking sector strongly correlates to profitability.

At the heart of the environmental pillar's ascendance to importance lies the climate risk that should be mitigated. Garel and Petit-Romec (2021) examined equity returns across a broad spectrum of US-listed companies. They found that better management of environmental risks in general and climate risk in particular result in superior equity returns. Their results amidst the COVID-19 pandemic indicate that climate risk is still ranked higher than other challenges facing humanity (Garel & Petit-Romec, 2021; Krueger et al., 2020; Ramelli et al., 2021). Environmental groups and investors are exerting pressure on companies to disclose their exposure to climate risk and how it is mitigated. Such pressure is more pronounced in large companies because their size makes them more visible, resulting in higher stakeholder and societal expectations (Ben-Amar & McIlkenny, 2015; Kouloukoui et al., 2019). In order to avoid this pressure, public companies are expected to disclose accurate information about their climate risk contribution, exposure, and mitigation efforts (Kouloukoui et al., 2019; Nowicki, 2018).

Climate Risk Disclosure Framework. Despite the importance of climate risk, there is no standard, universal climate risk disclosure framework that companies can use to facilitate comparability (Eleftheriadis & Anagnostopoulou, 2015; Griffin & Jaffe, 2022.). This paper discusses how companies in different jurisdictions use different frameworks to disclose risk. Griffin and Jaffe (2022) contended that Europe and Asia largely follow a corporate governance model different from the US. The dispersed shareholder model mostly dominates the US, while the former's governance model is similar to the South African model of block-holding. The US TCFD mandated in jurisdictions like South Africa, which follows the European governance model, might differ. Many climate change-related litigations have overwhelmed the courts in Global North versus a few in Global North, which is a testament to the differences in corporate governance models used in these jurisdictions (Pattajoshi, 2022).

However, the Johannesburg Stock Exchange (JSE) has published the JSE sustainability disclosure guidance, which was aimed at assisting companies to disclose climate risk information. The document is aligned with the International Financial Reporting Standards (IFRS) IFRS S1, IFRS S2, and TCFD (JSE, 2022). It is commendable that the JSE has sought to develop this disclosure guidance and align it with some of the leading frameworks. However, TCFD has not only been regarded as a baseline sustainability framework but has also been developed for a different jurisdiction, the US, which has a corporate governance model predicated on dispersed shareholders with a higher level of shareholder activism (Griffin & Jaffe, 2022.) The TCFD might not be compatible with the South African environment.

Myriad risk disclosure studies that have recently been conducted in South Africa, such as Denhere (2022), Iredele and Moloi (2020), and Lemma et al. (2020), have all ignored the recent JSE sustainability guidance in evaluating companies' risk disclosure even though the framework aimed at directing climate change-related disclosure of South African listed companies which were also

CATRA RESEARCH INSTITUTE
• ISSN 2720 - 9644 (print)
• ISSN 2721 - 0871 (online)
IJESSS
INTERNATIONAL JOURNAL OF ENVIRONMENTAL, SUSTAINABILITY AND SOCIAL SCIENCE
Indexed By :
GARUDA Google doi Crossref ROAD INDEX COPERNICUS oneSearch ISJD sinta 4 EBSCO Clarivate Analytics

their units of analysis. Among these studies, only Iredele and Moloi (2020) focused on the mining sector, even though the mining sector is more susceptible to climate risk than other sectors. Therefore, the extent to which the South African mining sector complies with the JSE sustainability still needs to be fully understood. Greenwood and Warren (2022) assert that the research focus should be directed explicitly at climate risk rather than a high-level ESG assessment. This study, therefore, contributes to the body of knowledge by developing a climate risk disclosure checklist based on JSE sustainability guidelines. This checklist is used to assess the relationship between climate risk disclosure and the performance of JSE-listed companies.

Hypotheses Development, Climate Risk Disclosure in Line with the JSE Sustainability Guideline. Literature on corporate social responsibility (CSR), ESG, and climate risk suggests that mining and other extractive industries are more prone to environmental risk and climate change than other industries (Griffin & Jaffe, 2022; Iredele & Moloi, 2020). According to Lemma et al. (2020), it is a sector dominating the South African economy. Its dominance was also witnessed in the 2021/2022 fiscal period, in which it contributed enormously to the country's fiscus, resulting in extra revenue of about R182 billion (Qobo & Soko, 2022). Although the JSE sustainability guidelines target all South African listed companies, many of its disclosure aspects are expected to feature prominently in mining companies' integrated reports, given the sector's vulnerability to climate risk. The hypothesis is developed for the above as follows:

H1. The mean score for climate risk disclosure among the sampled listed mining companies should indicate that the majority disclose most of the items enshrined in the JSE sustainability guideline.

Climate Risk Disclosure and Market-Based Performance Measures. According to the World Economic Forum (WEF) (2020), environmental risk is among the world's top five risks, and the risk is severe in terms of likelihood and impact. Climate risk or global warming caused the WEF to categorize environmental risk among the top in the world (Ramelli & Wagner, 2020). Climate risk ultimately translates to economic and financial risk to companies, thereby impacting future cashflow-generating prospects (Kouloukoui et al., 2018; Nordhaus, 2019). As a result, stakeholders tend to reward companies that exhibit adequate climate risk disclosure (Lins et al., 2019). Lin and Wu (2023). posit that such a disclosure mitigates information asymmetry between the managers and external stakeholders, shielding companies from devaluation. Therefore, the second hypothesis of the study is stated as follows:

H2. There is a positive relationship between climate risk disclosure score and mining company performance as measured by the market-based metrics, namely, Tobin's Q, economic value added (EVA), and market value added (MVA)

Climate Risk Disclosure and Accounting-Based Performance Measures. Consistent with expectations for increased stakeholder support for companies that exhibit adequate climate risk disclosure (Lins et al., 2019), it is expected that accounting-based measures should also increase for such companies. It is supported by Kouloukoui et al. (2019), who investigated how climate change is managed among Brazilian companies and found a statistically significant positive relationship between firm profitability and climate performance. Therefore, the third hypothesis of this study is stated as follows:

H3. There is a positive relationship between climate risk disclosure score and mining company performance as measured by the accounting-based metrics, namely, return on equity (ROE), return on assets (ROA), and earnings per share (EPS).

METHODS

The study followed a quantitative research method using secondary data based on the integrated reports of mining companies listed on the JSE from 2016 to 2021.

CATRA RESEARCH INSTITUTE
• ISSN 2720 - 9644 (print)
• ISSN 2721 - 0871 (online)
IJESSS
INTERNATIONAL JOURNAL OF ENVIRONMENTAL, SUSTAINABILITY AND SOCIAL SCIENCE
Indexed By : GARUDA Google doi Crossref ROAD INDEX COPERNICUS OneSearch ISJD sinta 4 EBSCO Clarivate Analytics

Sample Description. Mining was selected because it is one of the sectors susceptible to environmental challenges in general and climate risk in particular. At the time of data collection, 36 mining companies were listed per the IRESS database (formerly known as McGregor BFA). IRESS is one of the leading financial databases most scholars in South Africa use. Based on this, all 36 mining companies were included in the sample, implying that the entire population was examined. However, only some companies reported all the variables consistently over the period under review, 2016 through 2021. Therefore, the study resulted in 216 observations, an unbalanced dataset of 36 companies from 2016 to 2021.

Variables Used in the Study, Independent Variables. Consistent with the stated hypothesis, both the accounting-based and market-based performance measures constituted the independent variables of this study. These variables are described in table 1 below:

Table 1. Independent variables and their description

Accounting-based performance measures	Label	Description	Data source
ROA	Return on assets	A percentage is calculated as profit (pre-tax and interest) divided by the total assets.	IRESS database
ROE	Return on equity	A percentage is calculated as profit (pre-tax and interest) divided by the shareholders' equity.	IRESS database
EPS	Earnings per share	Net profit after tax less preference dividends divided by the weighted average shares outstanding	IRESS database
			IRESS database
Market-based performance measures			IRESS database
Tobin's Q	Tobin's Q or Q-ratio	A ratio calculated as total assets plus market value of assets less book value of equity divided by total assets	IRESS database
MVA	Market value added	The market value of a company less the total amount of capital invested	IRESS database
EVA	Economic value added	Net profit after tax less capital charge	IRESS database

Source: Author's conception

Independent Variables. The only independent variable used in this study is the climate risk disclosure score. An unweighted disclosure index (checklist) was developed based on the JSE

CATRA RESEARCH INSTITUTE
• ISSN 2720 - 9644 (print)
• ISSN 2721 - 0871 (online)
IJESSS
INTERNATIONAL JOURNAL OF ENVIRONMENTAL, SUSTAINABILITY AND SOCIAL SCIENCE
Indexed By :

sustainability disclosure guidance (Appendix A). The checklist was then used to score the companies on the quality of climate risk disclosure. The index contained a total of twelve items. Consistent with Kouloukoui et al. (2019), content analysis of the integrated reports was conducted manually based on the checklist and the critical elements of climate risks that must be disclosed in terms of JSE sustainability disclosure guidance.

Validity and Reliability of the Unweighted Disclosure Index. Validity and reliability are relevant considerations for a content analysis conducted in this study to determine the climate risk disclosure score. Marston and Shrives (1991) define reliability as the measurement tool's ability to provide the same results when different scholars use it consistently. The unweighted disclosure index used in this study could be considered reliable if two researchers can have the same conclusion or results using the same index (Omar & Simon, 2011). In order to achieve this, two reviewers were involved in scoring the companies' integrated reports. Initially, the reviewers reviewed the first five companies together to ensure they both came to the same conclusion regarding the scores allocated to the companies. Those were discussed in instances of differences, and the agreement was reached. Then, one reviewer continued reviewing and scoring all the sampled companies for the period under review. The senior reviewer independently reviewed and checked the integrated reports against the unweighted disclosure index until a consensus was reached on the appropriate score for each integrated report.

Control Variable. Revenue was used as a proxy for company size. Studies such as Suttipun and Stanton (2012) also used revenue to control for company size. The dependent variables discussed above-obtained revenue from the IRESS database.

Procedure for Data Collection. A climate risk disclosure score for all six years, 2016 through 2021, was collected using an unweighted disclosure index developed based on JSE climate change disclosure requirements. As discussed above, the score allocated represented an independent variable. On the other hand, the dependent variables (ROA et al.'s Q, MVA, and EVA) and the control variable (revenue) for the period 2016 to 2021 were all collected directly from the IRESS database over two months period, 01 May 2022 until 30 June 2022.

RESULT AND DISCUSSION

Descriptive Statistics. The study results are presented below, starting with the descriptive statistics in Table 2.

Table 2. Descriptive Statistics

		EPS (R)	ROA (%)	ROE (%)	Tobin Q ratio	EVA (R)	MVA (R)	Climate risk disclosure (%)
N	**Valid**	215	215	215	216	214	215	216
	Missing	1	1	1	0	2	1	0
Mean		618	-18	-0,46	2,78	64 000	0,91	32
Median		12	1,43	1,58	0,68	-36 000	0,76	32
Standard deviation		1713	107	34	8,27	11 000 000	1,43	22
Skewness		4	-4	-2,42	4	-0,87	0,95	0,24
Kurtosis		18	24	14	21	25	8	-0,85
Minimum		-445	-732	-242	-0,17	-85 000 000	-5	0
Maximum		11554	344	91	56	69 000 000	9	83,33

Source: Author's compilation from SPSS

As indicated in Table 2 above, the average climate risk disclosure score was only 32%, as indicated by the mean score. It indicates that the JSE-listed mining companies have yet to make

CATRA RESEARCH INSTITUTE
• ISSN 2720 - 9644 (print)
• ISSN 2721 - 0871 (online)
IJESSS
INTERNATIONAL JOURNAL OF ENVIRONMENTAL, SUSTAINABILITY AND SOCIAL SCIENCE
Indexed By : GARUDA, Google Scholar, doi Crossref, ROAD, Index Copernicus, Indonesia OneSearch, ISJD, sinta 4, EBSCO, Clarivate Analytics Web of Science

strides in disclosing climate risk-related information despite numerous available frameworks calling for such disclosure. The International Integrated Reporting Council issued the International Integrated Reporting Framework (IIRF) in December 2010 (IIRC, 2013).

It has already required companies to disclose the extent to which they use natural capital as part of the total six capitals that the company has to create value over time. It is in addition to the Global Reporting Initiative (GRI) and other frameworks, such as SEC and TCFD, that have been in force for a while. The negative mean values on ROE ROA and the negative minimum values on all the performance metrics are concerning. The climate risk disclosure reflects the overall poor disclosure among the South African listed companies despite the significance of environmental considerations in the sector.

The regression modeling was conducted in Eviews 11, a statistical software package that allows for the econometric analysis of unbalanced panel data. First, The modeling approach involved fitting the model using ordinary least squares (OLS) estimation. No multicollinearity exists between the single independent and control variables (r=-0.054), far below the threshold of 0.8. The assumptions of no autocorrelation, homoskedasticity, and normally distributed errors were assessed by studying the value of the Durbin-Watson test statistic, conducting the test for heteroskedasticity and ensuring robust standard error estimates if applicable, and studying the distribution of the error term. As a rule of thumb, Durbin-Watson test statistic values in the range of 1.5 to 2.5 are generally considered the range between which serial correlation is not a concern. However, according to Field (2013), a Durbin-Watson statistic value below one or more than 3 is a definite cause for concern. In the case of a value outside these thresholds, the Hausman test was conducted to determine if a fixed or random model applies. The models are presented per financial performance measure.

Regression Modelling Results, Earnings per share (EPS). Table 3 summarises the first analysis conducted on the data, panel least squares regression, i.e., ordinary least squares (OLS) for EPS.

Table 3. Panel Least Squares Regression for EPS

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-593.0153	166.9262	-3.552559	0.0005
CLIMATE RISK DISCLOSURESCORE	31.90336	3.641436	8.761201	0.0000
TURNOVER	2.69E-08	3.21E-08	0.839139	0.4027
		R-squared		0.328849
		Adjusted R-squared		0.320299
		F-statistic		38.46322
Durbin-Watson stat	0.528106	Prob(F-statistic)		0.000000

Source: Author's compilation from Eviews11

The results indicated the presence of autocorrelation as indicated by the Durbin-Watson statistics of 0.53. Furthermore, it was necessary to test the assumption of homoskedasticity. The results indicated that the null hypothesis is rejected ($p<0.05$); therefore, the residuals were heteroskedastic for the cross section (company) dimension, but it is not rejected for the period dimension ($p>0.05$). As a result, it was decided to determine if a random or fixed effect model applies to the data using the Hausman test.

The Hausman test indicated that the null hypothesis was not rejected ($p=0.1132$), suggesting that a random model applies. However, conducting the random model still indicated the presence of autocorrelation (Durban-Watson = 0.53), which needed to be addressed.

Therefore, to address the presence of autocorrelation and heteroskedasticity, Estimated Generalised Least Squares (EGLS) with period SUR estimates were used. The model corrects heteroskedasticity while a general correlation of observations within a cross-section was applied. White diagonal standard errors and covariance is a robust standard error and covariance estimation method. The results are presented in Table 4 below.

Table 4. Panel EGLS for EPS to Address Autocorrelation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-90.04214	65.94229	1.365469	0.1741
CLIMATE RISK DISCLOSURESCORE	17.03632	3.165632	5.381649	0.0000
TURNOVER	8.37E-09	1.18E-08	0.708755	0.4795
Weighted Statistics				
		R-squared		0.213411
		Adjusted R-squared		0.203391
		F-statistic		21.29802
Durbin-Watson stat	1.282647	Prob(F-statistic)		0.000000

Source: Author's compilation from Eviews11

The results in Table 4 indicated that autocorrelation was addressed as the result of Durbin Watson indicating a value of 1.282647 between the acceptable thresholds of 1 and 3 (Field, 2013).

From the results in Table 4, the climate risk disclosure score is a statistically significant predictor of EPS at the 5% significance level when company size is also controlled. The percentage of variance explained (adjusted R square) is 20.3%, and the F test of the regression model was statistically significant (F=21.298; p<0.01).

Economic Value Added (EVA). Panel least squares regression, or ordinary least squares (OLS) on panel data, is the initial analysis done on EVA data, and the output is presented in Table 5.

Table 5. Panel Least Squares Regression for EVA

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2863366.	1049065.	-2.729446	0.0071
CLIMATE RISK DISCLOSURESCORE	91723.63	22841.41	4.015673	0.0001
TURNOVER	-0.000139	0.000203	-0.685338	0.4941
		R-squared		0.098683
		Adjusted R-squared		0.087127
		F-statistic		8.540009
Durbin-Watson stat	0.725443	Prob(F-statistic)		0.000302

Source: Author's Own Compilation from Eviews11

The output in Table 5 above indicates that autocorrelation was present, and the results were corroborated by the Durbin-Watson statistics of 0.73 (Huck, 2012; Lusk et al., 2011). Additionally, the homoskedasticity assumption was tested. The residuals were heteroskedastic for the cross-section (company) dimension since the findings showed that the null hypothesis was rejected (p<0.05). In contrast, it was not rejected for the period dimension (p > 0.05). Therefore, for the data in this investigation, the OLS solution is not a statistically sound regression model for EVA. As a result, it was decided to use the Hausman test to evaluate if a random or fixed effect model was applied to the data. The null hypothesis was rejected at the 5% (p=0.0761) significance level. Table 6 provides the output from the fixed effects model.

CATRA RESEARCH INSTITUTE
• ISSN 2720 - 9644 (print)
• ISSN 2721 - 0871 (online)
IJESSS
INTERNATIONAL JOURNAL OF ENVIRONMENTAL, SUSTAINABILITY AND SOCIAL SCIENCE
Indexed By :

Table 6. Fixed Effects Model Test for EVA

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-6240605.	1488236.	-4.193289	0.0001
CLIMATE RISK DISCLOSURESCORE	164423.1	35791.67	4.593891	0.0000
TURNOVER	0.000288	0.000332	0.868927	0.3865
Effects Specification				
Cross-section fixed (dummy variables)				
		R-squared		0.509558
		Adjusted R-squared		0.385001
		F-statistic		4.090970
Durbin-Watson stat	1.405486	Prob(F-statistic)		0.000000

Source: Author's compilation from Eviews11

The findings showed that autocorrelation Durbin-Watson's value of 1.41 was within the allowed range of 1 to 3 (Akter, 2014). Climate risk disclosure score is a statistically significant predictor of EVA at the 5% significance level when company size is controlled. The percentage of variance explained is 38.5%, and the F-test of the regression model was statistically significant ($F=4.09$; $p<0.05$).

Market value added (EVA). Ordinary least squares (OLS) on panel data were used in the initial analysis of the data, which is a panel least squares regression. Table 7 below provides the output.

Table 7. Panel Least Regression for EVA

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.662308	0.149474	4.430908	0.0000
CLIMATE RISK DISCLOSURESCORE	0.011194	0.003243	3.451991	0.0007
TURNOVER	-7.77E-11	2.87E-11	-2.703189	0.0076
		R-squared		0.113800
		Adjusted R-squared		0.102582
		F-statistic		10.14465
Durbin-Watson stat	0.201110	Prob(F-statistic)		0.000072

Source: Author's compilation from Eviews11

According to the Durbin-Watson statistics of 0.2, the results revealed the presence of autocorrelation in the data (Huck, 2012; Lusk et al., 2011). The residuals for the cross-section (company) dimension were heteroskedastic because the results showed that the null hypothesis was rejected ($p<0.05$). In contrast, it was not rejected for the period dimension ($p > 0.05$). The Hausman Test was subsequently performed to determine if a fixed or random model is applicable. The null hypothesis was not rejected ($p=0.2062$), indicating that a random model applies. However, autocorrelation was still present in the data and must be addressed.

Therefore, in order to address the presence of autocorrelation and heteroskedasticity as shown above (Durbin Watson = 0.2), period SUR estimates that correct for heteroskedasticity and general correlation of observations within a cross-section were applied, as well as White diagonal standard errors and covariance, which is a robust standard error estimation method and thus ensure that the statistical significance values are not influenced by heteroskedasticity. Table 8 shows the results once the Panel EGLS was applied.

CATRA RESEARCH INSTITUTE
• ISSN 2720 - 9644 (print)
• ISSN 2721 - 0871 (online)
IJESSS
INTERNATIONAL JOURNAL OF ENVIRONMENTAL, SUSTAINABILITY AND SOCIAL SCIENCE
Indexed By : GARUDA Google doi Crossref ROAD INDEX COPERNICUS OneSearch ISJD sinta 4 EBSCO Clarivate Analytics

Table 8. Panel EGLS for MVA

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.623964	0.151692	4.113371	0.0001
CLIMATE RISK DISCLOSURESCORE	0.006233	0.002734	2.280038	0.0239
TURNOVER	-2.92E-11	1.97E-11	-1.482272	0.1403
Weighted Statistics				
		R-squared		0.050123
		Adjusted R-squared		0.038099
		F-statistic		4.168652
Durbin-Watson stat	0.703211	Prob(F-statistic)		0.017208
Unweighted Statistics				
R-squared	0.057432	Mean dependent var		0.959789
Sum squared resid	129.4274	Durbin-Watson stat		0.157197

Source: Author's compilation from Eviews11

However, autocorrelation was still an issue after Panel EGLS was conducted. A lagged term was introduced, and the following panel least squares regression in Table 9 was determined.

Table 9. Panel Least Regression for MVA

Variable	Coefficient	Std. Error	t-Statistic	Prob.
MVAWINS (-1)	0.972778	0.066727	14.57848	0.0000
C	0.048287	0.066831	0.722524	0.4713
CLIMATE RISK DISCLOSURESCORE	0.001347	0.001997	0.674346	0.5013
TURNOVER	2.13E-13	1.28E-11	0.016648	0.9867
		R-squared		0.833964
		Adjusted R-squared		0.830102
		F-statistic		215.9793
Durbin-Watson stat	1.325098	Prob(F-statistic)		0.000000

Source: Author's compilation from Eviews11

According to the regular residual graph, the condition of normality was fulfilled because the Skewness (0.81) and kurtosis (7.64-3=4.64) were between the permitted ranges of -2 and 2 for Skewness and -7 to +7 for kurtosis.

Return on Assets (ROA). A panel least squares regression was performed. Table 10 represents the outcomes obtained from the panel least square regression regarding ROA.

Table 10. Panel Least Regression for ROA

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-21.59190	5.094458	-4.238312	0.0000
CLIMATE RISK DISCLOSURESCORE	0.503534	0.110518	4.556124	0.0000
TURNOVER	2.36E-09	9.79E-10	2.407874	0.0172
	29.63062	R-squared		0.138714
	1.093412	Adjusted R-squared		0.127811
	9.676074	F-statistic		12.72328
Durbin-Watson stat	0.705120	Prob(F-statistic)		0.000008

Source: Author's compilation from Eviews11

CATRA RESEARCH INSTITUTE
• ISSN 2720 - 9644 (print)
• ISSN 2721 - 0871 (online)
IJESSS
INTERNATIONAL JOURNAL OF ENVIRONMENTAL, SUSTAINABILITY AND SOCIAL SCIENCE
Indexed By : GARUDA, Google Scholar, doi Crossref, ROAD, INDEX COPERNICUS, Indonesia OneSearch, ISJD, sinta 4, EBSCO, Clarivate Analytics Web of Science

The results demonstrated autocorrelation in the data, as demonstrated by the Durbin-Watson statistics, which is 0.71 (Huck, 2012; Lusk et al., 2011). In addition, the homoskedasticity assumption had to be verified. The residuals for the cross-section (company) dimension were heteroskedastic as results showed that the null hypothesis was rejected ($p < 0.05$), while it was not rejected for the period dimension ($p > 0.05$). Consequently, it was decided to use the Hausman test to assess whether a random or fixed effect model best explains the data.

The p-value was less than 0,05 (p=0.0294); therefore, the fixed effect model applies. The fixed model regression yielded the results presented in Table 11.

Table 11. Panel Least Squares Regression for ROA

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-9.316000	6.583233	-1.415110	0.1595
CLIMATE RISK DISCLOSURESCORE	0.217101	0.157585	1.377675	0.1707
TURNOVER	1.41E-09	1.44E-09	0.979967	0.3290
Effects Specification				
Cross-section fixed (dummy variables)				
		R-squared		0.616604
		Adjusted R-squared		0.520755
		F-statistic		6.433080
Durbin-Watson stat	1.450569	Prob(F-statistic)		0.000000

Source: Author's compilation from Eviews11

The results indicated that autocorrelation was addressed as the result of Durbin-Watson indicating a value of 1.45 between the acceptable thresholds of 1 and 3 (Akter, 2014). The regular residual graph indicated that the normality assumption is met (Skewness and kurtosis were within the acceptable threshold of -2 and 2 for Skewness and -7 to +7 for kurtosis). The Skewness for the residuals is -1,07, and kurtosis is 6.16.

Return on equity (ROE). The initial analysis of the data is a panel least squares regression. The outcomes are presented in Table 12.

Table 12. Panel Least Squares Regression for ROE

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-10.74018	3.708003	-2.896485	0.0043
CLIMATE RISK DISCLOSURESCORE	0.353327	0.080097	4.411255	0.0000
TURNOVER	1.13E-09	7.07E-10	1.601237	0.1113
		R-squared		0.119238
		Adjusted R-squared		0.108018
		F-statistic		10.62738
Durbin-Watson stat	1.375396	Prob(F-statistic)		0.000047

Source: Author's compilation from Eviews11

The results indicated a Durbin-Watson value 1.37, between the acceptable thresholds of 1 and 3 (Akter, 2014). The regular residual graph indicated that the normality assumption is met - (Skewness and kurtoses were within the acceptable threshold of -2 and 2 for Skewness and -7 to +7 for kurtosis). The Skewness for the residuals is -1,04, and kurtosis is 4,71.

CATRA RESEARCH INSTITUTE
• ISSN 2720 - 9644 (print)
• ISSN 2721 - 0871 (online)
IJESSS
INTERNATIONAL JOURNAL OF ENVIRONMENTAL, SUSTAINABILITY AND SOCIAL SCIENCE
Indexed By : GARUDA, Google Scholar, doi Crossref, ROAD, Index Copernicus International, Indonesia OneSearch, ISJD, sinta 4, EBSCO, Clarivate Analytics Web of Science

Tobin's Q. Tobin Q's ratio analysis used panel least squares regression, as presented in Table 13.

Table 13. Panel Least Squares Regression for Tobin's Q

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.757206	0.368050	4.774367	0.0000
CLIMATE RISK DISCLOSURESCORE	-0.012543	0.007984	-1.570927	0.1182
TURNOVER	-1.49E-10	7.07E-11	-2.100615	0.0373
		R-squared		0.039767
		Adjusted R-squared		0.027612
		F-statistic		3.271702
Durbin-Watson stat	0.396417	Prob(F-statistic)		0.040528

Source: Author's compilation from Eviews11

According to the Durbin-Watson statistics of 0,4, the findings showed that the data had autocorrelation (Huck, 2012; Lusk et al., 2011). Additionally, the homoskedasticity assumption needed to be verified. The residuals for the cross-section (company) dimension were heteroskedastic because the results showed that the null hypothesis was rejected ($p < 0.05$). However, it was not rejected for the period dimension ($p > 0.05$).

As a result, the OLS solution is not a statistically sound regression model for the data in this investigation. Consequently, it was decided to use the Hausman test to assess if a random or fixed effect model fitted the data.

The p-value is less than 0,05 (p=0.0004); therefore, the null hypothesis was rejected, and the fixed effect model applies. The fixed model regression yielded the results summarised in Table 14.

Table 14. The Fixed Effects Model for Tobin's Q

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.805069	0.311165	2.587274	0.0108
CLIMATE RISK DISCLOSURESCORE	0.005572	0.007448	0.748008	0.4558
TURNOVER	2.18E-11	6.81E-11	0.319849	0.7496
Effects Specification				
Cross-section fixed (dummy variables)				
		R-squared		0.817038
		Adjusted R-squared		0.771297
		F-statistic		17.86241
Durbin-Watson stat	1.865698	Prob(F-statistic)		0.000000

Source: Author's compilation from Eviews11

Although the fixed effect model addressed the autocorrelation concern, the regular residual graph indicated that the normality assumption was unmet. Skewness of 3.75 was outside the acceptable threshold of -2 and 2.

Therefore, Panel EGLS (period SUR) with White diagonal standard errors and covariance were conducted, and the results are presented in Table 15 below.

Table 15. Panel EGLS for Tobin's Q

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.130056	0.190332	5.937284	0.0000

CATRA RESEARCH INSTITUTE
• ISSN 2720 - 9644 (print)
• ISSN 2721 - 0871 (online)
IJESSS
INTERNATIONAL JOURNAL OF ENVIRONMENTAL, SUSTAINABILITY AND SOCIAL SCIENCE
Indexed By : GARUDA, Google Scholar, doi Crossref, ROAD, Index Copernicus International, Indonesia OneSearch, ISJD, Sinta 4, EBSCO, Clarivate Analytics Web of Science

CLIMATE RISK DISCLOSURESCORE	-0.002424	0.003662	-0.661944	0.5090
TURNOVER	-7.20E-11	2.53E-11	-2.847187	0.0050
Weighted Statistics				
		R-squared		0.019569
		Adjusted R-squared		0.007159
Durbin-Watson stat	1.253660	Prob(F-statistic)		0.209866
Unweighted Statistics				
R-squared	0.020471	Mean dependent var		1.049230
Sum squared resid	752.6025	Durbin-Watson stat		0.361488

Source: Author's compilation from Eviews11

The regular residual graph indicated that there was still a slight issue with the assumption of normality, as the kurtosis is 8.63 (11.63-3). However, in light of Kline's (2011) contention that problems can be indicated

by absolute values of Skewness greater than 3, Kurtosis greater than 10, and values above 20, and that violations of the normality assumption have little effect on results in large sample sizes (i.e. when there are more than ten observations for each variable), the results presented above were therefore regarded as valid (Schmidt, 2017).

Table 16 below summarises the relationship between climate risk disclosure and different performance measures, as spelled out in the passages above.

Table 16. A Table Representing the Inferential Statistics for Mining Companies Listed on the JSE from 2016 to 2021

Variables	**Coefficient**	**t-statistic**	**Significance (p-Value)**	**Durban-Watson Statistic**	**F-statistics**	**Adjusted r square value**
EPS	17,03632	5,381649	0	1,282647	21,3	0,2
EVA	164423,1	4,593891	0,38	1,405486	4,09	0,39
MVA	0,048287	0,722524	0,4713	1,325098	215,98	0,83
ROA	0,217101	1,377675	0,1707	1,450569	6,4	0,52
ROE	0,331137	3,503928	0,0006	1,665578	6,98	0,07
Tobin Q	-0,02	-0,66	0,21	1,25	1,57	0,02

Source: Author's compilation from Eviews11

All the results in this table are reliable and valid, as the Durban-Watson statistic for all variables was between the threshold of 1 and 3. A positive correlation suggests that as the independent variable (climate risk disclosure) improves, the dependent variable (performance measure) likewise improves, and vice versa. Conversely, a negative coefficient suggests that when the climate risk disclosure increases, that specific metric decreases, and vice versa. All the results show a positive relationship between climate risk disclosure and firm performance, except for Tobin Q. Tobins Q is negatively correlated to climate risk disclosure. It is shown with a negative coefficient and t-statistic. It means that the disclosure or lack of disclosure of climate risk within a company will not determine or impact the market value of that company. P-values, which are lower than 0,05,

CATRA RESEARCH INSTITUTE
• ISSN 2720 - 9644 (print)
• ISSN 2721 - 0871 (online)
IJESSS
INTERNATIONAL JOURNAL OF ENVIRONMENTAL, SUSTAINABILITY AND SOCIAL SCIENCE
Indexed By : GARUDA Google Crossref ROAD INDEX COPERNICUS oneSearch ISJD sinta 4 EBSCO Clarivate Analytics

show the statistical significance of the results. As shown in Table 16, EPS and ROE showcase statistically significant results.

CONCLUSION

The study's main aim was to develop an unweighted climate risk disclosure index to assess whether the climate risk disclosure predicts mining companies' performance. The results of this study suggested that the mining companies' climate risk disclosure is significant in predicting company performance as proxied by earnings per share (EPS), economic value added (EVA), and return on equity (ROE).

The findings are consistent with prior studies such as Sukmadilaga, Winarningsih, Yudianto, Lestari, and Ghani (2023), who found that green accounting reporting, specifically emissions, significantly positively impacts companies' EVA. It is also supported by Almashhadani and Almashhadani (2023), who found that sustainability reporting significantly influences the return on equity (ROA) in Bahraini-listed companies. In identifying the main homogeneous groups of Romanian listed companies after environmental, social, economic, and governance disclosure (ESG) and earnings per share, as well as investigating the relationship between these variables, Popa, Bogdan, Popa, Belenesi and Badulescu (2022) also found a statistically significant relationship between ESG disclosure and EPS.

Unsurprisingly, the extent of climate risk disclosure based on the unweighted disclosure index developed in this study is generally lower at the average disclosure of 32% because climate risk disclosure is optional. Ebaid (2023) also found that sustainability reporting among the companies listed on the Saudi Stock Exchange is low. The extractive industry and the mining sector, mainly, are more exposed to climate risk because of the more significant greenhouse gas emissions. Therefore, policymakers and standard setters are encouraged to develop a standardized climate risk reporting framework and make it mandatory for companies to report on this crucial metric.

The primary limitation of this study is that only mining companies were investigated. Future studies could expand into other sectors of the economy and seek to establish whether low climate risk disclosure is prevalent across all industries. A cross-country study that compares the level of climate risk disclosure in the extractive industries could also be informative.

REFERENCES

Adamkaite, J., Streimikiene, D., & Rudzioniene, K. (2023). The impact of Social Responsibility on Corporate Financial Performance in the Energy Sector: Evidence from Lithuania. *Corporate Social Responsibility and Environmental Management*. https://doi.org/10.1002/csr.2340

Agyei-Mensah, B. K., & Buertey, S. (2019). Do Culture and Governance Structure Influence Extent of Corporate Risk Disclosure? *International Journal of Managerial Finance*. https://doi.org/10.1108/IJMF-09-2017-0193

Alkurdi, A., Hussainey, K., Tahat, Y., & Aladwan, M. (2019). The Impact of Corporate Governance on Risk Disclosure: Jordanian Evidence. *Academy of Accounting and Financial Studies Journal, 23*(1), 1-16.

Almashhadani, M., & Almashhadani, H. A. (2023). The Impact of Sustainability Reporting on Promoting Firm Performance. *International Journal of Business and Management Invention, 12*(4), 101-111.

CATRA RESEARCH INSTITUTE
• ISSN 2720 - 9644 (print)
• ISSN 2721 - 0871 (online)
IJESSS
INTERNATIONAL JOURNAL OF ENVIRONMENTAL, SUSTAINABILITY AND SOCIAL SCIENCE
Indexed By :

Baalouch, F., Ayadi, S. D., & Hussainey, K. (2019). A study of the Determinants of Environmental Disclosure Quality: Evidence from French Listed Companies. *Journal of Management and Governance, 23*(4), 939–971. https://doi.org/10.1007/s10997-019-09474-0

Ben-Amar, W., & McIlkenny, P. (2015). Board Effectiveness and the Voluntary Disclosure of Climate Change Information. *Business Strategy and the Environment, 24*(8), 704–719. https://doi.org/10.1002/bse.1840

Borghei, Z. (2021). Carbon Disclosure: A Systematic Literature Review. *Accounting & Finance, 61*(4), 5255–5280. https://doi.org/10.1111/acfi.12757

Brodny, J., & Tutak, M. (2020). Using Artificial Neural Networks to Analyze Greenhouse Gas and Air Pollutant Emissions from the Mining and Quarrying Sector in the European Union. *Energies, 13*(8), 1925. https://doi.org/10.3390/en13081925

Brogi, M., & Lagasio, V. (2019). Environmental, Social, Governance, and Company Profitability: Are Financial Intermediaries Different? *Corporate Social Responsibility and Environmental Management, 26*(3), 576-587. https://doi.org/10.1002/csr.1704

Brown, C., Alexander, P., Arneth, A., Holman, I., & Rounsevell, M. (2019). Achievement of Paris Climate Goals Unlikely Due to Time Lags in the Land System. *Nature Climate Change, 9*(3), 203–208. https://doi.org/10.1038/s41558-019-0400-5

Bruwer, M., Scholtz, S. E., De Beer, L. T., & Rothmann, J. C. (2022). The Human Capital Risk Reporting of Listed South African Companies: Exploring a Reporting Framework to Support Corporate Governance. *Administrative Sciences, 12*(4), 123. https://doi.org/10.3390/admsci12040123

Dagestani, A. A., Qing, L., & Abou Houran, M. (2022). What Remains Unsolved in Sub-African Environmental Exposure Information Disclosure*: A Review. Journal of Risk and Financial Management, 15*(10), 487. https://doi.org/10.3390/jrfm15100487

Denhere, V. (2022). Sustainability: The Adoption of Green Economy and Sustainable Accounting Principles by South African Listed Companies and Lessons Learnt. *International Journal of Research in Business and Social Science (2147–4478),* 11(5), 366–376. https://doi.org/10.20525/ijrbs.v11i5.1810

Ebaid, I. E. S. (2023). Nexus Between Sustainability Reporting and Corporate Financial Performance: Evidence from an Emerging Market. *International Journal of Law and Management*, (ahead-of-print). https://doi.org/10.1108/IJLMA-03-2022-0073

Ebhuoma, E. E. (2022). COVID-19 Hard Lockdown in South Africa: Lessons for Climate Stakeholders Pursuing the Thirteenth Sustainable Development Goal. *Journal of Asian and African Studies, 57*(5), 897-910. https://doi.org/10.1177/00219096211043922

Eleftheriadis, I. M., & Anagnostopoulou, E. G. (2015). Relationship Between Corporate Climate Change Disclosures and Firm Factors. *Business Strategy and the Environment, 24*(8), 780–789. https://doi.org/10.1002/bse.1845

Elshandidy, T., Elmassri, M., & Elsayed, M. (2022). Integrated Reporting, Textual Risk Disclosure, and Market Value. *Corporate Governance: The International Journal of Business in Society, 22*(1), 173-193. https://doi.org/10.1108/CG-01-2021-0002

Erdoğan, S., Çakar, N. D., Ulucak, R., & Kassouri, Y. (2021). The Role of Natural Resources Abundance and Dependence in Achieving Environmental Sustainability: Evidence from Resource-Based Economies. *Sustainable Development, 29*(1), 143-154. https://doi.org/10.1002/sd.2137

Eriksen, S., Schipper, E. L. F., Scoville-Simonds, M., Vincent, K., Adam, H. N., Brooks, N., ... & West, J. J. (2021). Adaptation Interventions and Their Effect on Vulnerability in Developing

CATRA RESEARCH INSTITUTE
• ISSN 2720 - 9644 (print)
• ISSN 2721 - 0871 (online)
IJESSS
INTERNATIONAL JOURNAL OF ENVIRONMENTAL, SUSTAINABILITY AND SOCIAL SCIENCE
Indexed By : GARUDA Google doi Crossref ROAD INDEX COPERNICUS oneSearch ISJD sinta 4 EBSCO Clarivate Analytics

Countries: Help, Hindrance or Irrelevance? World Development, 141, 105383. https://doi.org/10.1016/j.worlddev.2020.105383

Fifka, M. S. (2013). Corporate Responsibility Reporting and its Determinants in Comparative Perspective–A Review of the Empirical Literature and a Meta-Analysis. *Business strategy and the environment*, *22*(1), 1–35. https://doi.org/10.1002/bse.729

Flammer, C., Toffel, M. W., & Viswanathan, K. (2021). Shareholder Activism and Firms' Voluntary Disclosure of Climate Change Risks. *Strategic Management Journal*, *42*(10), 1850-1879. https://doi.org/10.1002/smj.3313

Franken, G., & Schütte, P. (2022). Current Trends in Addressing Environmental and Social Risks in Mining and Mineral Supply Chains by Regulatory and Voluntary Approaches. *Mineral Economics*, *35*(3-4), 653-671. https://doi.org/10.1007/s13563-022-00309-3

Garel, A., & Petit-Romec, A. (2021). Investor Rewards to Environmental Responsibility: Evidence from the COVID-19 Crisis. *Journal of Corporate Finance*, *68*, 101948. https://doi.org/10.1016/j.jcorpfin.2021.101948

Gatzert, N., & Reichel, P. (2022). Awareness of Climate Risks and Opportunities: Empirical Evidence on Determinants and Value from the US and European Insurance Industry. *The Geneva Papers on Risk and Insurance-Issues and Practice*, *47*(1), 5-26. https://doi.org/10.1057/s41288-021-00227-5

Greenwood, N., & Warren, P. (2022). Climate Risk Disclosure and Climate Risk Management in UK Asset Managers. *International Journal of Climate Change Strategies and Management*, (ahead-of-print). https://doi.org/10.1108/IJCCSM-09-2020-0104

Griffin, P., & Jaffe, A. M. (2022). Challenges for a Climate Risk Disclosure Mandate. *Nature Energy*, *7*(1), 2–4. https://doi.org/10.1038/s41560-021-00929-z

Gustafsson, M. T., Rodriguez-Morales, J. E., & Dellmuth, L. M. (2022). Private Adaptation to Climate Risks: Evidence from the World's Largest Mining Companies. *Climate Risk Management*, *35*, 100386. https://doi.org/10.1016/j.crm.2021.100386

Guthrie, J., Manes Rossi, F., Orelli, R. L., & Nicolò, G. (2020). Investigating Risk Disclosures in Italian Integrated Reports. *Meditari Accountancy Research*, *28*(6), 1149–1178. https://doi.org/10.1108/MEDAR-10-2019-0596

Haddaway, N. R., Smith, A., Taylor, J. J., Andrews, C., Cooke, S. J., Nilsson, A. E., & Lesser, P. (2022). Evidence of the Impacts of Metal Mining and the Effectiveness of Mining Mitigation Measures on Social-Ecological Systems in Arctic and Boreal Regions: A Systematic Map. *Environmental Evidence*, *11*(1), 30. https://doi.org/10.1186/s13750-022-00282-y

Handayani, K., Filatova, T., Krozer, Y., & Anugrah, P. (2020). Seeking for a Climate Change Mitigation and Adaptation Nexus: Analysis of a Long-Term Power System Expansion. *Applied Energy*, *262*, 114485. https://doi.org/10.1016/j.apenergy.2019.114485

Henningsson, J. (2019). Will the Banker Become a Climate Activist? Challenges in Managing Sustainable Business: Reporting, Taxation, Ethics and Governance, 231-249. https://doi.org/10.1007/978-3-319-93266-8_10

Ho, V. H. (2022). *Modernizing ESG Disclosure*. U. Ill. L. Rev., p. 277.

IIRC. (2013). *International Framework*. Retrieved from https://www.integratedreporting.org/wp-content/uploads/2013/12/13-12-08-THE-INTERNATIONAL-IR-FRAMEWORK-2-1.pdf

Iredele, O. O., & Moloi, T. (2020). Corporate Environmental Disclosure in the Integrated Reporting Regime: The Case of Listed Mining Companies in South Africa. *Journal of Economic and Financial Sciences*, *13*(1), 11. https://doi.org/10.4102/jef.v13i1.481

Jegede, A. O., & Makulana, A. W. (2019). Climate Change Interventions in South Africa: The Significance of Earthlife Africa Johannesburg v Minister of Environmental Affairs (Thabametsi

case) [2017] JOL 37526 (GP). Obiter, 40(2), 399-407. https://doi.org/10.17159/obiter.v40i2.11271

Kouloukoui, Gomes, S., Marinho, M., Torres, E. A., Kiperstok, A., & de Jong, P. (2018). Disclosure of Climate Risk Information by the World's Largest Companies. *Mitigation and Adaptation Strategies for Global Change, 23*(8), 1251-1279. https://doi.org/10.1007/s11027-018-9783-2

Kouloukoui, Sant'Anna, A. M. O., da Silva Gomes, S. M., de Oliveira Marinho, M. M., de Jong, P., Kiperstok, A., & Torres, E. A. (2019). Factors Influencing the Environmental Disclosures in Sustainability Reports: Case of Climate Risk Disclosure by Brazilian Companies. *Corporate Social Responsibility and Environmental Management, 26*(4), 791-804. https://doi.org/10.1002/csr.1721

Lee, S. Y. (2012). Corporate Carbon Strategies in Responding to Climate Change. *Business Strategy and the Environment, 21*(1), 33–48. https://doi.org/10.1002/bse.711

Lee, S. Y., Park, Y. S., & Klassen, R. D. (2015). Market Responses to Firms' Voluntary Climate Change Information Disclosure and Carbon Communication. *Corporate Social Responsibility and Environmental Management, 22*(1), 1-12. https://doi.org/10.1002/csr.1321

Lemma, T. T., Shabestari, M. A., Freedman, M., Lulseged, A., & Mlilo, M. (2020). Corporate Carbon Risk, Voluntary Disclosure and Debt Maturity. *International Journal of Accounting & Information Management, 28*(4), 667-683. https://doi.org/10.1108/IJAIM-06-2019-0064

Lins, K. V., Servaes, H., & Tamayo, A. (2019). Social Capital, Trust, and Corporate Performance: How CSR Helped Companies During the Financial Crisis (and Why it Can Keep Helping Them). *Journal of Applied Corporate Finance, 31*(2), 59-71. https://doi.org/10.1111/jacf.12347

Matemane, R., Moloi, T., & Adelowotan, M. (2022). Appraising Executive Compensation ESG-Based Indicators Using Analytical Hierarchical Process and Delphi Techniques. *Journal of Risk and Financial Management, 15*(10), 469. https://doi.org/10.3390/jrfm15100469

Marston, C. L., & Shrives, P. J. (1991). The use of Disclosure Indices in Accounting Research: A Review Article. *The British Accounting Review, 23*(3), 195–210. https://doi.org/10.1016/0890-8389(91)90080-L

Meinshausen, M., Lewis, J., McGlade, C., Gütschow, J., Nicholls, Z., Burdon, R., ... & Hackmann, B. (2022). Realization of Paris Agreement Pledges May Limit Warming Just Below 2 C. *Nature, 604*(7905), 304-309. https://doi.org/10.1038/s41586-022-04553-z

Murguía, D. I., & Bastida, A. E. (2023). Critical and Energy Transition Minerals in Argentina: Mineral Potential and Challenges for Strengthening Public Institutions. *Geological Society, London, Special Publications, 526*(1), SP526-2022. https://doi.org/10.1144/SP526-2022-172

Muttanachai, S., & Stanton, P. (2012). Determinants of Environmental Disclosure in Corporate Annual Reports. *International Journal of Accounting and Financial Reporting, 2*(1), 99-115. https://doi.org/10.5296/ijafr.v2i1.1458

Nowiski, N. (2018). Rising Above the Storm: Climate Risk Disclosure and its Current and Future Relevance to the Energy Sector. *Energy LJ, pp. 39*, 1

Odell, S. D., Bebbington, A., & Frey, K. E. (2018). Mining and Climate Change: A Review and Framework for Analysis. *The Extractive Industries and Society, 5*(1), 201–214. https://doi.org/10.1016/j.exis.2017.12.004

Omar, B. & Simon, J. (2011). 'Corporate Aggregate Disclosure Practices in Jordan.' *Advances in Accounting, 27*(1), pp 166–186. https://doi.org/10.1016/j.adiac.2011.05.002

Pattajoshi, N. (2022). Assessing the Climate of 'Shareholder Based Climate Change Litigation' in the Global South. In: European Yearbook of International Economic Law. Springer, Berlin, Heidelberg. https://doi.org/10.1007/8165_2022_89

Popa, D. N., Bogdan, V., Sabau Popa, C. D., Belenesi, M., & Badulescu, A. (2022). Performance Mapping in Two-Step Cluster Analysis through ESEG Disclosures and EPS. *Kybernetes, 51*(13), 98-118. https://doi.org/10.1108/K-08-2021-0672

Qin, P., Xu, H., Liu, M., Xiao, C., Forrest, K. E., Samuelsen, S., & Tarroja, B. (2020). Assessing Concurrent Effects of Climate Change on Hydropower Supply, Electricity Demand, and Greenhouse Gas Emissions in China's Upper Yangtze River Basin. *Applied Energy, 279*, 115694. https://doi.org/10.1016/j.apenergy.2020.115694

Raemaekers, K., Maroun, W., & Padia, N. (2016). Risk Disclosures by South African Listed Companies Post-King III. *South African Journal of Accounting Research, 30*(1), 41–60. https://doi.org/10.1080/10291954.2015.1021583

Ramelli, S., & Wagner, A. F. (2020). Feverish Stock Price Reactions to COVID-19. *The Review of Corporate Finance Studies, 9*(3), 622–655. https://doi.org/10.1093/rcfs/cfaa012

Simpson, N. P., Williams, P. A., Mach, K. J., Berrang-Ford, L., Biesbroek, R., Haasnoot, M., ... & Trisos, C. H. (2023). Adaptation to Compound Climate Risks: A Systematic Global Stocktake. *Iscience, 26*(2). https://doi.org/10.1016/j.isci.2023.105926

Sukmadilaga, C., Winarningsih, S., Yudianto, I., Lestari, T. U., & Ghani, E. K. (2023). Does Green Accounting Affect Firm Value? Evidence from ASEAN Countries. *International Journal of Energy Economics and Policy, 13*(2), 509. https://doi.org/10.32479/ijeep.14071

Vera, I., Goosen, N., Batidzirai, B., Hoefnagels, R., & van der Hilst, F. (2022). Bioenergy Potential from Invasive Alien Plants: Environmental and Socio-Economic Impacts in Eastern Cape, South Africa. *Biomass and Bioenergy, 158*, 106340. https://doi.org/10.1016/j.biombioe.2022.106340

Von Arx, U., & Ziegler, A. (2014). The Effect of Corporate Social Responsibility on Stock Performance: New Evidence for the USA and Europe. *Quantitative Finance, 14*(6), 977-991. https://doi.org/10.1080/14697688.2013.815796

Wahh, W. B., Khin, E. W. S., & Abdullah, M. (2020). Corporate Risk Disclosure in Emerging Economies: A Systematic Literature Review and Future Directions. *Asian Journal of Accounting Perspectives, 13*(2), 17-39. https://doi.org/10.22452/AJAP.vol13no2.2

Zumente, I., & Bistrova, J. (2021). ESG Importance for Long-Term Shareholder Value Creation: Literature Vs. Practice. *Journal of Open Innovation: Technology, Market, and Complexity, 7*(2), 127. https://doi.org/10.3390/joitmc7020127